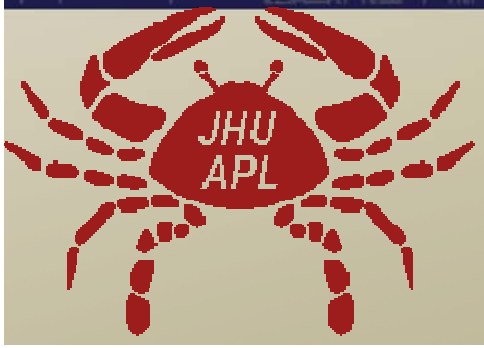
CRABS Software Use for the Weather Information Communication Program

Stephen Giguere
http://adsb.jhuapl.edu



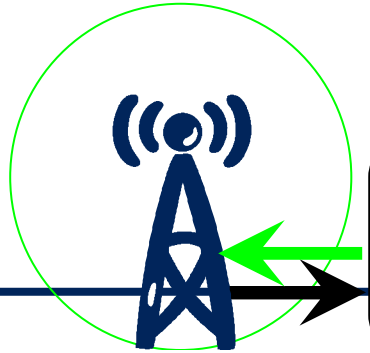
APL
The Johns Hopkins University
APPLIED PHYSICS LABORATORY

Presentation Outline

- Introduction to Automatic Dependent Surveillance Broadcast (ADS-B)
- Comprehensive Real-time Analysis of Broadcast Systems (CRABS) Capabilities and Implementations
- WINCOMM Implementation
- CRABS Demonstration

Automatic Dependent Surveillance Broadcast - Introduction

- ADS-B Broadcasts Include
  - Identification
  - Position
  - Velocity
  - Navigation Uncertainty
  - Climb or Descent Rate
  - Heading
  - Aircraft Category

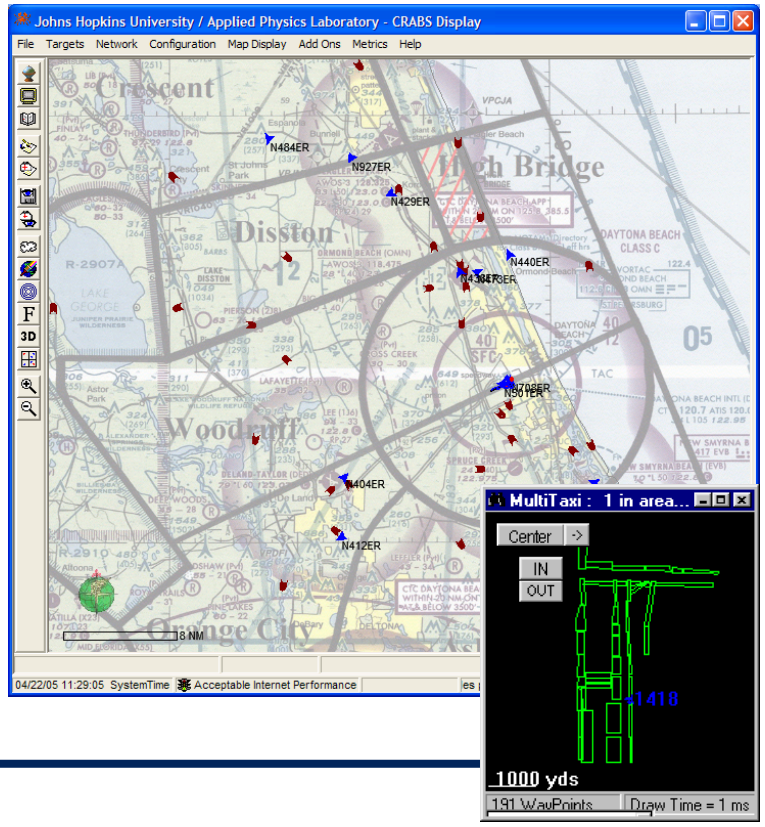


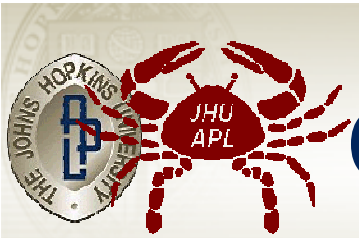
Control Facility

CRABS Capabilities

JHU/APL has developed the CRABS software tools utilizing a PC based platform to collect, analyze, and distribute test data in real-time

- **Software features:**
  - **Supports multiple data formats**
  - **2D or 3D display**
  - **Individual target analysis**
  - **Real-time metrics**
  - **Automated data archiving**
  - **Playback**





CRABS Capabilities

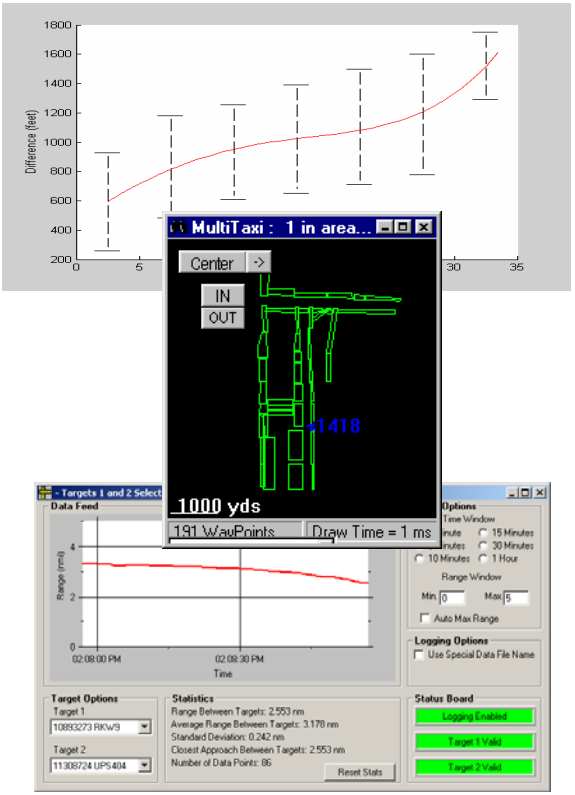
- **Component-based**
- **New functionality derived from reassembling components**
- **Flexible architecture**
- **Rapid prototyping**
- **Comprehensive workspace for multiple data sources**

APL

Metric Utilization

APL has developed and implemented a number of metrics operating on the real-time datalink network

- **Engineering Metrics**
  - Data quality (spatial)
  - Track integrity (continuity)
  - CRC errors
  - Network throughputs
  - Update rates
  - Service volumes
  - Data availability
  - Network latencies
  - Sensor accuracy
- **Cost/Benefits Metrics**
  - Inflow
  - Runway extended centerline
  - Runway arrivals
  - Arrival spacing
  - Runway occupancy
  - Departure
  - Outflow
  - Flight time
  - Taxi Delays



Metrics can be available immediately after a test

CRABS Implementations

❑ Louisville, KY

- Common ARTS ASR-9 & ADS-B
- Surface Multilateration ASTERIX 11
- ASDE Radar
- Mode S ADS-B, UAT ADS-B
- ASTERIX 242 (GBT 2000 Health)

❑ Atlantic City, NJ

- ASTERIX 22 Fusion targets
- CD2 (w SGF Header)
- ASTERIX 21 (ADS-B)
- ASTERIX 22 (TIS-B)

❑ Anchorage, AK

- ASTERIX 21 ADS-B
- ASTERIX 242 (GBT 2000 Health)
- ASTERIX 22 (TIS-B)
- FIS-B (NEXRAD, METAR, TAF)
- ASTERIX 33 (ADS-B/TIS-B)
- ASTERIX 23 (NEXGEN GBT Status)

❑ Flight Monitoring Servers

- Laurel, MD
- Atlantic City, NJ
- Daytona Beach, FL
- Prescott, AZ

History

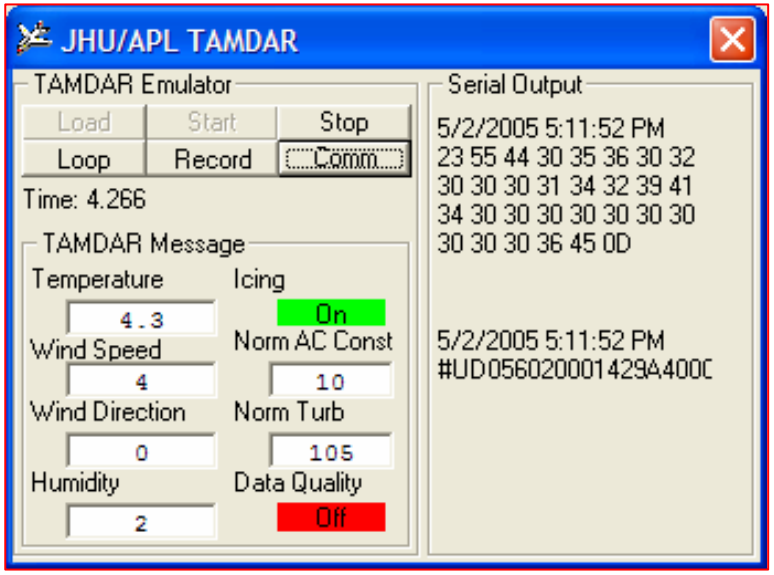
- **APL has utilized this system of data collection and analysis for:**
  - **Operational evaluations**
  - **Flight monitoring**
  - **Integration tests**
  - **Special studies**
  - **Long-term trend analysis**
  - **Monitoring capabilities**
    - Ground stations
    - ADS-B aircraft
    - TIS-B service

WINCOMM

- **This flight demonstration was designed to transfer weather information using the UAT ADS-B data link**
- **TAMDAR data includes**
  - Temperature
  - Wind speed
  - Wind Direction
  - Humidity
  - Icing
  - Turbulence
  - Data Quality
- **Experimental TAMDAR payload was placed in an unused field of a UAT message**
- **Modified avionics and ground station software was used to validate and transfer the TAMDAR payload**

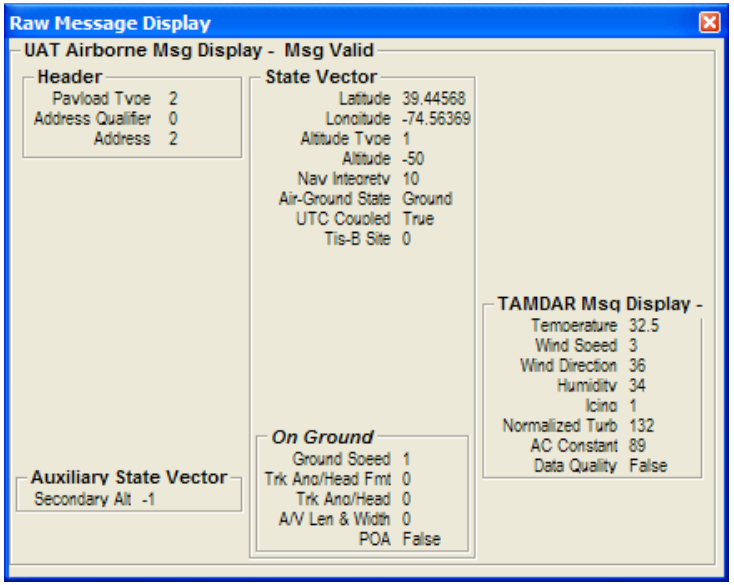
WINCOMM

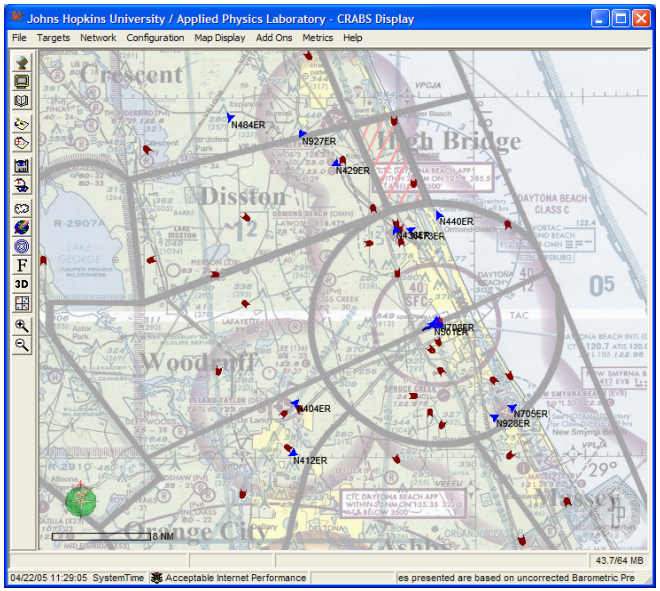
- CRABS components were used to develop
  - TAMDAR Emulator
    - Realistic TAMDAR payloads
    - Transferred TAMDAR data to modified avionics
    - Scenario file controls TAMDAR variables



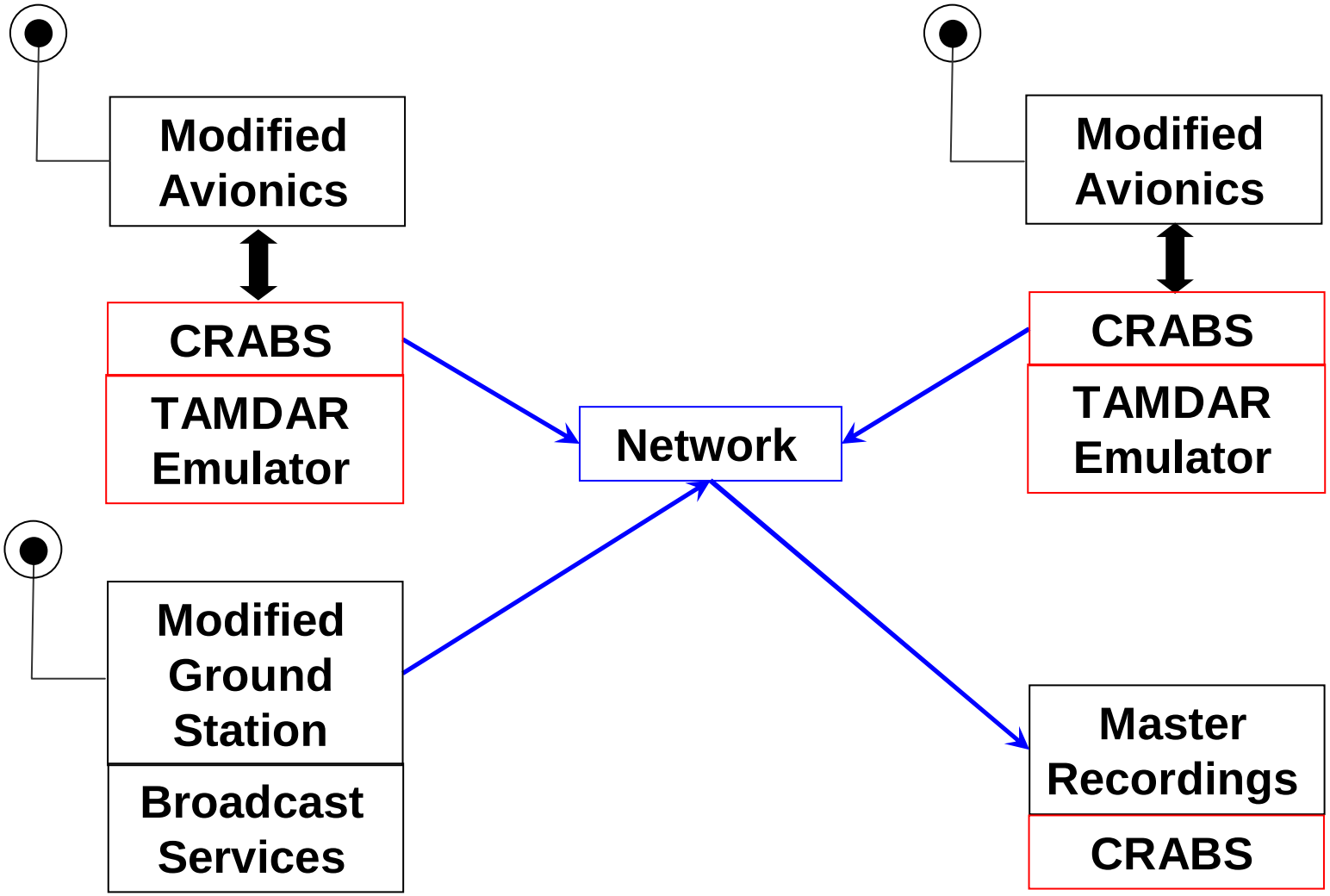
WINCOMM

- **Analysis Tool for Modified Software**
  - **Identified TAMDAR payloads**
  - **Verified payloads arrived at Control Facility**
- **Avionics Display Emulator**
  - **Driven by modified avionics**
  - **Displayed TAMDAR data**





WINCOMM Bench Test Configuration



WINCOMM Results

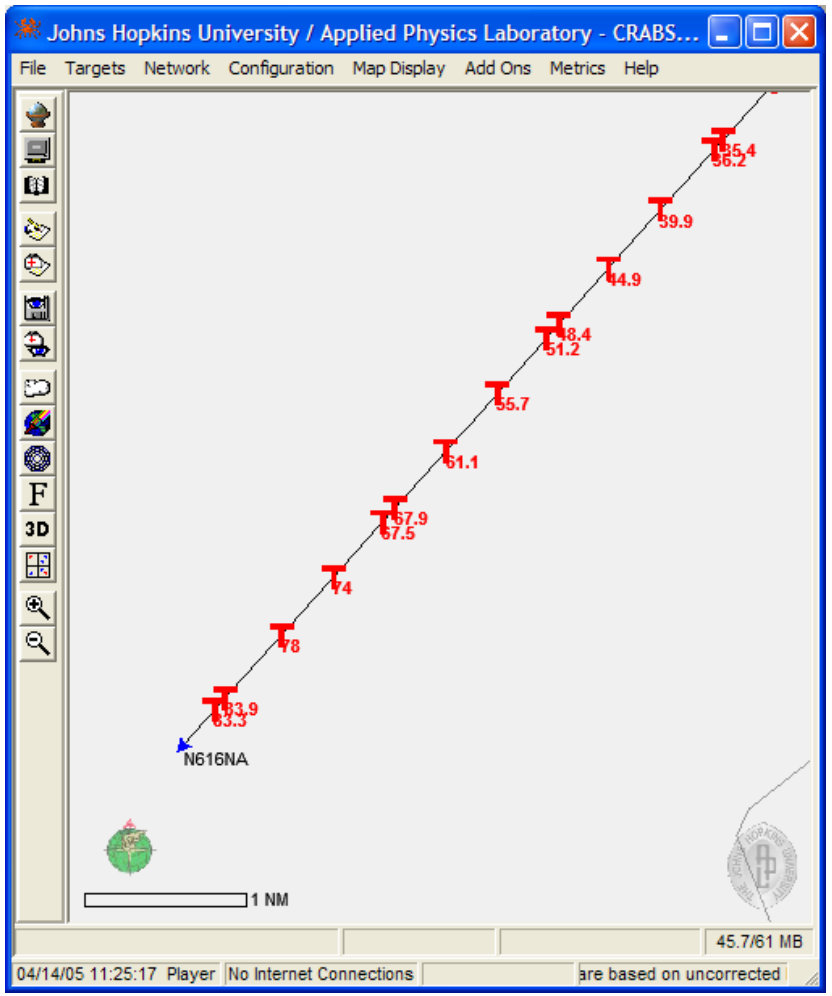
- All TAMDAR data was validated in real-time using CRABS analysis tools

- CRABS was used to monitor all transmissions and receptions while the test was in progress

Demonstration

- Flexible display
- Custom maps
- DirectX aircraft symbols
- DirectX 3D geometry

- TAMDAR Flight Test April 14, 2005
  - T symbols represent TAMDAR payloads
  - NASA Lear ADS-B aircraft
  - TIS-B RADAR tracks
  - FIS-B
    - NEXRAD
    - METAR
    - TAF



Automatic Dependent Surveillance Broadcast - Introduction

- **ADS-B Broadcasts Include**
  - **Identification**
  - **Position**
  - **Velocity**
  - **Navigation Uncertainty**
  - **Climb or Descent Rate**
  - **Heading**
  - **Aircraft Category**

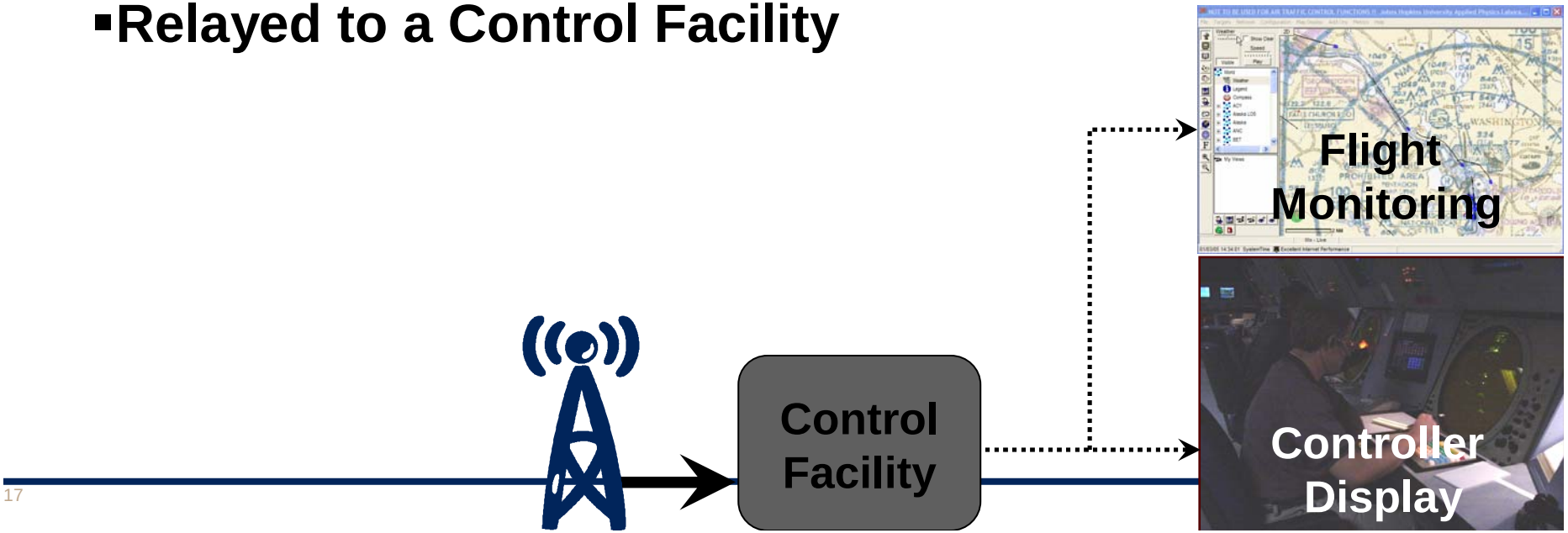
Automatic Dependent Surveillance Broadcast - Introduction

- **Air-Air ADS-B**
  - **Detected by ADS-B Equipped Aircraft**
  - **Presented to Pilots on a Multifunction Display**

Automatic Dependent Surveillance Broadcast - Introduction

Air to Ground

- **Detected by Ground Broadcast Transceivers**
- **Relayed to a Control Facility**



Automatic Dependent Surveillance Broadcast - Introduction

ADSB Broadcast Services

- **Traffic Information Services Broadcast (TIS-B)**
  - **Flight Information Services (FIS-B) Products**
    - **NEXRAD Weather**
    - **Generic Text Products**
    - **Expandable Format**